PRECUTTING SEED POTATOES FOR HIGHER QUALITY SEED AND GREATER RETURNS

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PRECUTTING SEED POTATOES FOR HIGHER QUALITY SEED AND GREATER RETURNS

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Seed potatoes are generally cut before planting, and this may often delay planting and cause spoilage. Delayed planting may result in substantial loss in yield and increased operation costs.

Studies relating to precutting seed potatoes began about 1921 and continued at research institutions in various potato-producing areas in the world. Information relating to precutting seed potatoes has been obtained on such subjects as disease control, losses during cutting, environment required for curing cut seed, storage requirements, transportation, economics, disease reduction in fields, and yields.

Bonde and Mullany (*4*)[1] cut and treated seed of the Irish Cobbler, Russet Rural, and Katahdin varieties and shipped it to farmers in the Eastern United States. They reported no significant differences in emergence and yield.

Bonde and Hyland (*3*) reported on the use of antibiotics and fungicide treatments on precut seed. Their data showed that 100 p/m of agrimycin solution reduced the amount of bacterial seed piece decay and the rate and extent to which the wound protective layer was formed. The combination of captan and agrimycin did not eliminate the effect of the antibiotic on the wound periderm layer in cut seed potatoes, nor did it reduce emergence or yield in Maine.

Sparks et al. (*10*) investigated factors affecting storage losses of 'Russet Burbank' potato tubers cut several months prior to planting. They found that potato seed pieces can be cut as early as February in Idaho without excessive loss if proper chemical treatment and suberizing conditions are provided.

[1]Italic numbers in parentheses refer to Selected References, p. 31.

Hruschka et al. (*7*) precut seed and healed the seed pieces during transit in railcars. Weight and disease losses were low during transit.

Wilson and Hunter (*12*) reported on extended bulk storage of precut seed potatoes.

Data presented here were collected during 1964–72 at the Potato Handling Research Center, Presque Isle, Maine, and the Red River Valley Potato Research Center, East Grand Forks, Minn.

STORAGE TESTS

Bulk Storage of Precut Seed

Materials and Methods

1969 Studies.—On March 7, 1969, 300 hundredweight of 'Kennebec' and Russet Burbank foundation seed potatoes were hand-cut to insure blocky 1.5– to 2–ounce disease-free seed pieces. Immediately after cutting, one-half of the seed pieces of each variety was placed in a rotating drum with 8–percent Dithane M–45 dust,[2] and the other half was similarly treated with 7–percent Polyram dust, both at 1 pound per hundredweight. As the treated precut seed emerged from the drum, it was elevated into bulk storage bins of 300–hundredweight capacity, equipped with devices to monitor temperature and relative humidity during the storage period. Air ducts of 1 cubic foot per minute per hundredweight of airflow capacity had been placed on the floor at the center of each bin before filling to supply air for suberization, or curing, and for warming or cooling the seed as required during the storage period.

Immediately after a bin was filled, environmental conditions required for curing were provided for 10 days by maintaining 55° F and 85–95 percent relative humidity within the bin. A constant forced airflow of 1 cubic foot per minute per hundredweight through the bins was maintained for the first 24 hours of storage to insure partial drying of the cut surface on the potatoes to prevent bacterial decay. For the remainder of the curing period, airflow was reduced to 15 minutes per hour. After the cut surfaces were well healed, the bins were cooled to 45° and the relative humidity kept at 85–95 percent. The airflow was maintained at 15 minutes per hour.

Two weeks prior to removal from the bins, the seed was warmed to 55° F by using outside air and suplemental heat.

[2]For chemical names and manufacturers, see appendix.

The relative humidity within the pile of cut seed was maintained as close as possible to 90 percent during this process.

Two and one-half months after cutting, five random samples were taken from each variety and chemical treatment. These samples were divided into two equal parts; one was scored for the amount of seed piece decay and degree of sprouting, and the other was planted in field plots to determine the stand and yield as compared to freshly cut treated seed. Each field plot had 50 seed pieces planted in rows 34 inches apart, with Kennebec seed spaced 9 inches in the rows and Russet Burbank 12 inches. The experimental design was a completely randomized block with five replications.

1970 Studies.—The 1969 procedures were modified in 1970 as follows: (1) Some seed was cured and stored in 1–ton pallet boxes as well as in bulk bins, (2) airflow was reduced from full time to 15 minutes per hour at 1 cubic foot per minute per hundredweight during the first 24 hours of the curing period to try to reduce the amount of shriveling observed in seed pieces near the air ducts in 1969, and (3) seed pieces were reduced from 50 to 25 per plot because of limited land available.

1971 Studies.—The 1969 procedures with the 1970 modifications were further modified by cutting the seed with mechanical cutters instead of hand cutters and by using only Dithane M–45 as a seed treatment.

Results and Discussion

1969 Studies.—Conditions for suberization were easily maintained with the forced-air ventilation system, insuring satisfactory healing of the cut surfaces. The cooling process after the curing period was inhibited because there was no method of adding moisture to the cool air to prevent drying and shriveling of the cut seed. Therefore the cooling period was shortened to try to reduce drying to a minimum. Even with these precautions, some seed pieces directly over the air ducts were shriveled when removed. The remainder of the seed was in excellent condition. It was firm and had sprouts one-fourth to one-half inch long. Although some of the seed pieces stuck together as they were removed from the bin, they came apart easily with no apparent damage. Disease incidence in both the precut and the whole seed used as a check was less than 0.1 percent for the storage period.

Some detrimental effects were noted in the precut chemically treated seed. The Kennebec variety had a lower stand count from precut than fresh-cut seed. This effect was not observed

with Russet Burbank. Although the stands of precut Kennebec were reduced, the yields were not (table 1).

Chemical treatment of precut Russet Burbank seed significantly increased stand and yield. With fresh-cut seed, no significant effect on stand was noted, but yield was increased by seed treatment. The fresh-cut untreated seed produced a stand almost equal to that of the precut treated seed but produced a significantly lower yield (table 1). This was due to seed pieces with varying degrees of decay producing weaker plants and thus lower yields.

1970 Studies.—Although seed pieces were rather firm, their sprouts were longer than desirable because cool temperatures inside storage could not be maintained once the outside temperature moderated. When compared with results obtained in 1969, shrinkage due to airflow was greatly lessened, and the relative humidity was more adequately controlled because centrifugal humidifiers were used.

The seed stored in pallets was in the same general condition as that in bulk bins.

The time of cutting and the seed treatment did not affect stand (table 2). However, seed treated with Polyram appeared initially to produce less vigorous plants. This has been a problem with

TABLE 1.—*Stand and yield of Kennebec and Russet Burbank potatoes from precut and fresh-cut seed chemically treated and stored in bulk, 1969*

Treatment[1]	Stand[2]	Yield[2]
Kennebec	*Percent*	*Cwt/acre*
Precut (check)	88.8a	289a
Precut + Dithane M-45	84.8a	292a
Precut + Polyram	89.2a	301a
Fresh cut (check)	94.0a	280a
Fresh cut + Dithane M-45	92.4a	280a
Fresh cut + Polyram	91.2a	295a
Russet Burbank		
Precut (check)	61.6 b	178 c
Precut + Dithane M-45	98.4a	301a
Precut + Polyram	95.2a	289a
Fresh cut (check)	93.2a	243 b
Fresh cut + Dithane M-45	99.2a	307a
Fresh cut + Polyram	99.6a	307a

[1]Dithane M-45 and Polyram applied to seed as 8- and 7-percent dusts, respectively, at 1 lb/cwt.

[2]Comparable values followed by no letters in common differ significantly at 5-percent level according to Duncan's multiple-range test.

TABLE 2.—*Stand of Kennebec and Russet Burbank potatoes from fresh-cut and precut seed chemically treated and stored in bulk for 2 months, 1970*

Treatment[1]	Kennebec[2]	Russet Burbank[2]
	Percent	*Percent*
Fresh cut (check)	98.0a	95.0a
Fresh cut + Dithane M-45	98.0a	98.0a
Precut + Dithane M-45	98.0a	98.5a
Fresh cut + Polyram	98.0a	100.0a
Precut + Polyram	96.7a	94.7a

[1]Dithane M-45 and Polyram applied to seed as 8- and 7-percent dusts, respectively, at 1 lb/cwt.

[2]Comparable values followed by no letters in common differ significantly at 5-percent level according to Duncan's multiple-range test.

Polyram even on fresh seed. The plots were inadvertently destroyed before yield data were collected.

1971 Studies.—The use of mechanical seed cutters greatly increased the speed with which the seed was cut. High quality seed pieces were obtained as long as the volume of seed cut per unit of time did not exceed the capacity of the cutter and the tubers entered the cutters with the longest axis at a 90° angle to the cutting knives.

Mechanical losses in cutting Kennebec seed with a "pickle slicer" type machine (Dilts-Wetzel) were 0.5 percent compared with 4.5 percent for Russet Burbank when using a "Russet type" cutter (Milestone). The weight loss of precut versus whole seed was determined by weighing samples of cut and whole seed at time of cutting and again at removal from the bin. The respective weight losses for March and May of precut and whole Kennebec seed were 4.6 and 1.1 percent and 4.8 and 0.6 percent for Russet Burbank.

The seed at removal from the bulk bins and pallet boxes was in excellent condition. The seed pieces were firm with very little shriveling, sprouting was at a minimum, and seed piece decay was less than 0.1 percent. Seed in the bulk bins held together to a greater extent than that in the pallet boxes, but no detrimental effects were observed.

There was no difference in stand or yield due to time of cutting (table 3).

TABLE 3.—*Stand and yield of Kennebec and Russet Burbank potatoes from seed precut in March and May, treated with Dithane M–45, and stored in bulk, 1971*

Variety and cutting date	Stand[1]	Yield[1]
	Percent	*Cwt/acre*
Kennebec:		
March	99a	411a
May	100a	385a
Russet Burbank:		
March	96a	380a
May	98a	383a

[1]Comparable values followed by no letters in common differ significantly at 5–percent level according to Duncan's multiple-range test.

Seed Precut Monthly and Stored Until Planted

Materials and Methods

1969 Studies.—Certified Kennebec, Katahdin, and Russet Burbank seed potatoes were obtained at harvest from seed growers and stored at 40° F and 90 percent relative humidity until removed for cutting. From December through May, 100 pounds of each variety were removed monthly from storage, warmed to 50°, washed except the unwashed check lot, hand-cut to produce blocky 1.5– to 2–ounce seed pieces, and chemically treated. The six treatments are listed in table 4.

The treated seed was transferred to boxes and placed in a curing chamber maintained at 60° F and 95 percent relative humidity. After 10 days the seed was transferred to storage at 40° and 90 percent relative humidity until removed for warming at 50° 3 days prior to planting. After the seed was warmed, it was scored for seed piece decay and degree of sprouting and then prepared for planting.

The Kennebec and Katahdin potatoes were planted for stand tests. Because of the great amount of seed piece decay, the Russet Burbank potatoes were not included in the field tests. Only time of cutting and treatments were studied because the variety identity was lost when the seed was mixed during cutting. Field plots were planted in a split-plot design with each plot consisting of 25 seed pieces planted 9 inches apart in rows 34 inches apart.

1970 Studies.—The 1970 studies were designed similarly to those in 1969. Modifications consisted of eliminating Kennebec but retaining Katahdin and Russet Burbank. The seed treatments

were reduced to five with the elimination of the talc treatment. Semesan Bel dust was replaced by 10–percent Benlate dust. Adverse weather and soil conditions delayed the scheduled May fresh cutting until June when the soil was suitable for planting. Curing and storage conditions were maintained at 55° and 40° F, respectively, with both at 95 percent relative humidity.

1971 Studies.—Changes in the 1970 studies were (1) Katahdin was discontinued, (2) additional data were obtained on weight loss of precut versus whole seed, and (3) the number of treatments was increased, as shown in table 7.

Results and Discussion

1969 Studies.—Unwashed seed of Russet Burbank had the highest incidence of fusarium seed piece decay followed by washed seed treated with talc, washed only, Polyram, and Dithane M–45 in that order. Kennebec and Katahdin followed the same general trend but to a much less degree. Seed of all varieties treated with Semesan Bel dust developed soft rot and completely rotted. Less than 0.1 percent of soft rot was observed in the other treatments.

Seed cut in December had the greatest loss of weight and that cut in April the least. Unwashed seed showed the greatest weight loss followed by washed seed treated with talc, washed only, Dithane M–45, and Polyram. This closely follows the order observed with seed piece decay and probably accounts for the major cause of weight loss.

The washing and chemical treatments had no effect on sprout growth. The longest sprouts of one-fourth to one-half inch were on seed pieces cut in February, March, and April. This was attributed to the increase in temperature during the cutting and curing period when tubers were not dormant.

Seed treatments had little if any effect on stand, whereas time of cutting did (table 4).

1970 Studies.—Katahdin seed pieces showed decay in both unwashed and washed treatments but not in the others (table 5). This indicates that seed treatment is necessary if seed is precut. The highest incidence of seed piece decay occurred in unwashed seed of Russet Burbank followed by washed seed and seed treated with Polyram and Dithane M–45. Complete control was achieved with Benlate. It was the most promising chemical tested in controlling seed piece decay followed by Dithane M–45 and Polyram.

TABLE 4.—*Stand of potatoes from seed cut monthly and treated with various chemicals, 1968–69*

Treatment[1] and cutting date	Stand[2]
	Percent
Unwashed (check):	
December	94.0ab
January	93.0 b
February	97.5a
March	93.0 b
April	93.0 b
May	93.5 b
Washed:	
December	88.0 c
January	96.0a
February	98.5a
March	87.0 c
April	94.5a
May	96.5a
Washed + Dithane M–45:	
December	92.5 b
January	96.5a
February	97.0a
March	92.5 b
April	95.0a
May	99.0a
Washed + Polyram:	
December	92.0 b
January	94.5a
February	97.5a
March	96.0a
April	94.0ab
May	99.5a
Washed + talc:	
December	99.0a
January	97.0a
February	94.0ab
March	96.0a
April	97.0a
May	99.0a
Washed + Semesan Bel:	
December	Rotted.
January	Do.
February	Do.
March	Do.
April	Do.
May	93.5 b

[1]Dithane M–45, Polyram, and Semesan Bell applied to seed as 8–, 7–, and 7.6–percent dusts, respectively, at 1 lb/cwt.

[2]Comparable values followed by no letters in common differ significantly at 5–percent level according to Duncan's multiple-range test.

TABLE 5.—*Amount of seed piece decay in Katahdin and Russet Burbank potatoes from seed cut monthly and treated with various chemicals, 1970*

Treatment[1] and cutting date	Amount of decay[2] in— Katahdin	Russet Burbank
	Percent	*Percent*
Unwashed (check):		
January	9.5 c	100.0 d
February	0 a	13.2 b
March	1.0a	18.0 b
April	0 a	3.2a
Washed:		
January	.5a	24.2 bc
February	.5a	11.9 b
March	4.5 b	4.0a
April	0 a	.4a
Washed + Dithane M–45:		
January	0 a	.4a
February	0 a	.7a
March	0 a	1.3a
April	0 a	.4a
Washed + Polyram:		
January	0 a	6.9ab
February	0 a	2.5a
March	0 a	2.0a
April	0 a	.4a
Washed + Benlate:		
January	0 a	0 a
February	0 a	0 a
March	0 a	0 a
April	0 a	0 a

[1]Dithane M–45, Polyram, and Benlate applied to seed as 8–, 7–, and 10–percent dusts, respectively, at 1 lb/cwt.

[2]Comparable values followed by no letters in common differ significantly at 5–percent level according to Duncan's multiple-range test.

No adverse effects on sprout growth were produced by any of the treatments. The final stands were highest with Russet Burbank seed treated with Polyram, Dithane M–45, and Benlate; otherwise, little if any effect on stand or yield was shown (table 6).

1971 Studies.—Unwashed seed pieces had the highest incidence of seed piece decay at every cutting followed by seed treated with Dithane M–45 spray, Polyram spray, washed, Bravo spray, Polyram dust, Benlate spray, Dithane M–45 dust, Mertect spray, and Benlate dust in that order (table 7).

TABLE 6.—*Stand and yield of Katahdin and Russet Burbank potatoes from seed cut monthly and treated with various chemicals, 1970*

Treatment and cutting date[1]	Stand[2]	Yield[2]
	Percent	*Cwt/acre*
KATAHDIN		
Unwashed (check):		
January	95.0a	250.5 d
February	99.5 f	302.8a
March	97.0 bcd	281.3 b
April	96.5abc	302.8a
May	95.0a	299.7a
Washed:		
January	98.0 def	259.8 d
February	97.5 cde	290.5ab
March	96.5abc	296.6 d
April	97.0 bcd	253.6 d
May	99.0 fg	293.6ab
Washed + Dithane M-45:		
January	99.0 fg	265.9 c
February	99.0 fg	267.4 c
March	96.5abc	281.3 b
April	98.5 efg	273.6 c
May	99.0 fg	264.4 c
Washed + Polyram:		
January	98.5 efg	281.7 b
February	99.0 fg	308.9a
March	97.5 cde	267.4 c
April	95.5ab	265.9 c
May	95.0a	279.7 bc
Washed + Benlate:		
January	97.5 cde	288.2 bc
February	98.0 def	236.7a
March	97.0 bcd	255.1 d
April	96.5abc	287.4 b
May	95.5ab	281.3 b
RUSSET BURBANK		
Unwashed (check):		
January	42.0a	141.4 g
February	53.5 b	176.8 f
March	79.5 c	187.1 e
April	83.5 d	258.2 c
May	98.0 f	261.3 c
Washed:		
January	87.0 d	267.4 c
February	89.5 de	253.6 c
March	90.0 de	269.0 c
April	94.0 e	239.8 d
May	99.0 f	267.4 c

See footnotes at end of table.

TABLE 6.—*Stand and yield of Katahdin and Russet Burbank potatoes from seed cut monthly and treated with various chemicals, 1970*—Continued

Treatment and cutting date[1]	Stand[2]	Yield[2]
	Percent	*Cwt/acre*
RUSSET BURBANK—continued		
Washed + Dithane M-45:		268.0 c
January	99.0 f	312.0ab
February	99.5 f	270.5 bc
March	97.5 f	316.6a
April	98.5 f	278.2abc
May	98.5 f	
Washed + Polyram:		
January	96.0 f	299.7ab
February	99.5 f	293.6abc
March	97.5 f	299.7ab
April	99.5 f	305.9ab
May	100.0 f	265.9 c
Washed + Benlate:		
January	99.5 f	305.9ab
February	100.0 f	258.2 c
March	97.5 f	275.1 c
April	98.5 f	295.1 bc
May	99.0 f	287.4abc

[1]Dithane M-45, Polyram, and Benlate applied to seed as 8-, 7-, and 10-percent dusts, respectively, at 1 lb/cwt.

[2]Comparable values followed by no letters in common differ significantly at 1-percent level according to Duncan's multiple-range test.

Highest yields were obtained with Dithane M-45 dust followed by Mertect spray, Benlate spray, and Polyram dust. The lowest yields were obtained from the unwashed and washed seed (table 8).

Conclusions

The storage tests have shown that seed can be cut, treated, and stored for as long as 5 months and still produce yields equal to or greater than those obtained with fresh-cut seed. Dithane M-45 has been the most satisfactory followed closely by Polyram.

Mertect and Benlate, neither of which has been cleared for use on potatoes, provided better control of fusarium tuber rot than either Dithane M-45 or Polyram. Another advantage of Mertect and Benlate is that both materials can be applied as sprays and still control diseases that neither Dithane M-45 nor Polyram can control economically.

TABLE 7.—*Amount of fusarium seed piece decay in Russet Burbank potatoes from seed cut monthly and treated with various chemicals, 1971*

Treatment[1]	Amount of decay[2] in—			
	January	February	March	April
	Percent	*Percent*	*Percent*	*Percent*
Unwashed	100 c	100 b	80 b	2
Washed	100 c	100 b	2 a	1.6a
Dusts:				
Dithane M-45	2 a	1.2a	.8a	.4a
Polyram	6 a	2.4a	4.4a	1.2a
Benlate	0 a	Rotted	0 a	0 a
Sprays:				
Dithane M-45	100 c	100 b	3.6a	1 a
Polyram	80 b	100 b	3.2a	1.2a
Benlate	8.4a	1.6a	.8a	.8a
Mertect	.4a	0 a	.8a	0 a
Bravo	100 c	7.6a	2.8a	.4a

[1]Dithane M-45, Polyram, and Benlate applied to seed, respectively, as 8-, 7-, 10-percent dusts at 1 lb/cwt and as sprays containing 80-, 80-, and 50-percent wettable powder at 2 lb/100 gal of water. Mertect and Bravo applied as sprays containing 60- and 70-percent wettable powder, respectively, at 2 lb/100 gal of water.

[2]Comparable values followed by no letters in common are significantly different at 5-percent level according to Duncan's multiple-range test.

TABLE 8.—*Stand and yield of Russet Burbank potatoes from seed cut monthly and treated with various chemicals, 1971*

Treatment[1] and cutting date	Stand[2]	Yield[2]
	Percent	*Cwt/acre*
Unwashed:		
January	8.0a	35.1a
February	28.0 b	159.2 cde
March	60.0 de	213.2 cdefgh
April	64.0 de	211.7 cdefgh
May	69.0 def	177.2 cdef
Washed:		
January	4.0a	15.7a
February	34.0 bc	142.4 bc
March	44.0 c	186.2 cdef
April	75.0 efg	242.7 defghi
May	65.0 def	198.1 cdefg
Dithane M-45:		
Dust:		
January	95.0 ij	414.1 opqr
February	99.5 j	448.1 r

See footnotes at end of table.

TABLE 8.—*Stand and yield of Russet Burbank potatoes from seed cut monthly and treated with various chemicals, 1971*—Con.

Treatment[1] and cutting date	Stand[2]	Yield[2]
	Percent	*Cwt/acre*
Dithane M-45—Continued		
Dust—Continued		
March	100.0 j	425.1 pqr
April	99.5 j	395.7 nopqr
May	99.5 j	428.0 qr
Spray:		
January	14.0a	67.3ab
February	42.0 bc	197.8 cdefg
March	80.0 fgh	308.9 fghijklmn
April	80.0 fgh	207.6 cdefgh
May	58.0 d	152.0 bc
Polyram:		
Dust:		
January	93.0 hij	351.8 klmnopqr
February	96.0 ij	372.9 lmnopqr
March	100.0 j	381.9 mnopqr
April	97.0 j	298.1 hijklm
May	93.0 j	287.1 fghijkl
Spray:		
January	31.0 bc	167.3 cdef
February	42.0 bc	166.8 cdef
March	62.0 de	250.1 efghij
April	64.0 de	157.2 cd
May	80.0 fgh	215.2 defgh
Benlate:		
Dust:		
January	96.0 ij	360.9 klmnopq
February	98.0 j	361.3 lmnopqr
March	100.0 j	338.7 jklmnop
April	98.0 j	283.6 ghijkl
May	97.0 j	332.6 ijklmnop
Spray:		
January	89.0 ghij	359.0 lmnopqr
February	95.0 ij	380.2 mnopqr
March	99.0 j	373.8 lmnopqr
April	95.0 ij	256.9 fghijk
May	98.0 j	319.0 ijklmno
Mertect:		
Spray:		
January	95.0 ij	385.1 mnopqr
February	99.0 j	403.7 opqr
March	99.0 j	389.8 mnopqr
April	99.5 j	332.3 ijklmnop
May	99.5 j	349.7 klmnopq

See footnotes at end of table.

TABLE 8.—*Stand and yield of Russet Burbank potatoes from seed cut monthly and treated with various chemicals, 1971*—Con.

Treatment[1] and cutting date	Stand[2]	Yield[2]
Bravo:	*Percent*	*Cwt/acre*
Spray:		
January	7.0a	27.8a
February	91.0 hij	384.0 mnopqr
March	81.0 fghi	297.5 hijklm
April	66.0 def	161.2 cde
May	78.0 fgh	212.0 cdefgh

[1]Dithane M-45, Polyram, and Benlate applied to seed, respectively, as 8-, 7-, and 10-percent dusts at 1 lb/cwt and as sprays containing 80-, 80-, and 50-percent wettable powder at 2 lb/100 gal of water. Mertect and Bravo applied as sprays containing 60- and 75-percent wettable powder, respectively, at 2 lb/100 gal of water.

[2]Comparable values followed by no letters in common are significantly different at 5-percent level according to Duncan's multiple-range test.

SHIPPING TESTS

Bulk Precut Seed in Railcars

Materials and Methods

Two varieties of seed potatoes, Norchip and Sebago, were cut with mechanical seed cutters, treated with 7.5-percent captan dust at 1 pound per hundredweight, and loaded in bulk directly into two hopper railcars. These cars were equipped with temperature and airflow systems and had a capacity of 180,000 pounds each. The seed was to be suberized during transit from Colorado to Florida by maintaining an environment within the cars necessary for this process to occur (*7*). Ryan thermometers were placed throughout the cars to monitor temperature during transit.

A third test car was loaded with precut seed of both varieties. Five hundredweight of whole seed potatoes of each variety were placed on top of the load for planting in the test plots as a comparison with the precut seed. The Norchip seed was cured at 50° F and 90 percent relative humidity for 4 days and the Sebago for 8 days prior to loading. The remainder of the test was the same as for the other two cars.

Upon arrival in Florida, samples of 1,000 seed pieces were collected and scored for seed piece decay. Field plots of 500 seed pieces per plot were planted in rows 40 inches apart with seed pieces 11 inches apart in the row. Stand and yield data were recorded from plantings of both the precut and the whole seed shipped in car 3 and cut at the time of planting.

Results

Temperatures recorded in the load of precut seed shipped in the first car averaged 58° F during transit and ranged from 28° to 85°. In the second car the diesel engine stopped for a while after the car was loaded and the temperature within the load decreased to 27°. In this car load temperatures averaged 63° during transit and ranged from 27° to 79°. Losses due to decay of the cut seed in the first two cars of 90 and 100 percent, respectively, were believed to be caused by mechanical failure in the diesel electric generator systems. When the engine stopped, air circulation through the cut seed ceased and the electric heating and cooling unit no longer regulated temperature. This failure of the environmental system occurred at a time critical for suberization. When the units were working properly again and the temperature of the load increased, decay had commenced before the environmental conditions for suberization were reached.

In the third car the temperature averaged 59° F during transit and ranged from 51° to 79°. The seed in this car arrived in excellent condition. Seed piece decay in compartments filled with Norchip was 0.2 percent and 4.8 percent in the compartment filled with Sebago.

The crop planted from the precut seed in this car emerged faster and grew as vigorously as the whole seed placed on top of the load and cut at the time of planting. Stands from the precut and fresh-cut seed averaged 73 and 40 percent, respectively. Yield from the precut seed was significantly greater than that from seed cut at planting (table 9).

TABLE 9.—*Yield of Norchip and Sebago potatoes from precut seed and seed cut at planting shipped in bulk from Colorado in different compartments of mechanical refrigerator hopper car to Florida, 1970*

Shipping compartment and type of seed	Yield[1]
A, Norchip:	*Cwt/acre*
Precut	108.9a
Fresh cut	34.3 b
B, Sebago:	
Precut	171.9a
Fresh cut	116.3a
C, Norchip:	
Precut	172.3a
Fresh cut	95.3 b

[1]Comparable values followed by no letters in common differ significantly at 1-percent level according to Duncan's multiple-range test.

Bagged Precut Seed in Trucks and Railcars

Materials and Methods

Russet Burbank seed was cut, treated, and placed in 1-ton pallet boxes for curing. During the curing period the environment was maintained at 45° F and 90 percent relative humidity. The treatments applied to the cut seed as dusts were Dustret–A, Dustret, and Polyram at 1 pound per hundredweight. The seed was stored for a month before being put in conventional 100-pound burlap bags and shipped by truck from the Red River Valley, Minn., to Pasco, Wash. Whole seed potatoes to be cut at planting and B-size seed potatoes for planting as comparisons with the precut seed were shipped from the same grower and planted on the same date. Upon arrival, samples were taken and seed piece decay was scored. Field plots were planted and stand and yield data obtained.

A railcar was loaded with Kennebec seed that had been precut, treated, cured, bagged, and shipped from the Red River Valley to California. Only the amount of seed piece decay at destination and temperature during transit were recorded in this test.

Results

The shipment by truck of bagged precut seed to Pasco, Wash., arrived in excellent condition with no decay in any of the treatments. Field plot data showed that precut seed treated with Dustret–A and Polyram reduced yields significantly (table 10).

TABLE 10.—*Stand and yield of Russet Burbank potatoes from precut treated seed bagged and shipped by truck from Red River Valley, Minn., to Pasco, Wash., 1971*

Treatment	Stand[1]	Yield[1]
	Percent	*Cwt/acre*
Fresh cut	81a	243.6 bc
Precut and—		
Dustret–A	65a	234.8a
Dustret	77a	248.0 bc
Polyram	75a	240.0ab
Whole seed	76a	251.0 c

[1]Comparable values followed by no letters in common differ significantly at 5-percent level according to Duncan's multiple-range test.

The car of bagged Kennebec seed shipped to California had 13-percent decay upon arrival in association with temperatures above 90° F in the load during transit.

Pallet Containers of Precut Seed in Trucks

Materials and Methods

Studies were conducted in 1970 and 1972 on shipping pallet containers of precut potatoes by truck. The four types of containers used were as follows:

	Size (inches)	*Capacity (pounds of potatoes)*
Fiberboard:		
Rectangular with bottom	38¾ by 38¾ by 38	1,400
Rectangular without bottom	41 by 34 by 28	1,000
Octagonal with top and bottom	38¾ by 38¾ by 40⅞	1,500
Wooden	43¼ by 43¼ by 41	1,700

The octagonal container had a built-in dumping mechanism.

1970 Study.—Potatoes were cut with a mechanical seed cutter, placed in two wooden and two of the larger rectangular fiberboard containers, and stacked for 2 days. The temperature was maintained at 50° F for curing purposes and to determine whether stationary stacking had any effect on the container or the seed. On the third day the containers were loaded into a van-type truck (not stacked), and a simulated 700-mile round trip was made over both a superhighway and a secondary highway. Temperatures in the van during transit ranged from 45° to 65°. At completion of the trip the containers were removed from the van and stacked to determine whether they had been weakened in any way during transit. Samples were taken from each container and observed for breakdown and general condition.

1972 Study.—Four octagonal and four of the smaller rectangular fiberboard containers were used in this study. Cut seed was put into two containers of each type, whole dry potatoes in one of each type, and whole washed potatoes in one of each type. The containers were stacked for 1 day and held at 50° F to determine whether the treatments had any effect on them before they were loaded into the truck. The containers were stacked and the ambient temperature was held at approximately 50° during transport for 4 days. The eight containers and the contents were examined upon completion of a 1,400-mile round trip to Presque Isle, Maine. All containers were subjected to stacking upon removal from the truck to determine whether transport had had any effect on stackability of the containers or the potatoes.

Results

1970 Study.—The results of this study showed that the wooden pallet box of 1,700-pound capacity was very durable, withstood transport well, and could be stacked with little effect on the container or contents. The larger fiberboard container of 1,400-pound capacity did not hold up as well. When stacked on completion of the trip, the sides collapsed to the level of the potatoes.

No bruising was detected in potatoes in the fiberboard container. The only noticeable damage was caused by slight chafing along the sides of the container. Potatoes in the wooden container, on the other hand, had a large amount of bruising caused by the sharp edges of the pallet box, especially from the reinforcing strip around the interior of the box at about middle height. No rot or other damage was found in potatoes in either type of container.

1972 Study.—The four octagonal fiberboard containers of 1,500-pound capacity and the four smaller rectangular fiberboard containers of 1,000-pound capacity and their contents were examined upon return to Presque Isle, Maine. All were in excellent condition and maintained their stackability. Upon removal of the potatoes from the containers, samples were collected and examined for damage and disease incidence. The same general trend was found as in the 1970 study. Potato samples from the bottom of the container were slightly bruised. Washed stock was in excellent condition without any visible breakdown as were the unwashed whole and the precut seed. The precut seed showed signs of suberization.

Discussion

Bulk and Bagged Precut Seed in Railcars and Trucks

The problems in shipping precut seed are the same as for whole seed—the inconsistency of mechanical railcars to function properly and maintain desired conditions within the cars. The complete loss when precut seed was loaded in bulk directly into cars and suberized during transit was unfortunate because it prevented further studies from being conducted. The method appears feasible as it was successfully accomplished in test shipments of bagged, freshly cut seed potatoes from Maine to locations on the East coast in the mid-fifties (*4, 7*). Continuation of this research seems feasible, once the mechanical failures of these cars are corrected.

In those tests where the correct conditions during transit were maintained, excellent results were obtained as to seed piece quality

and degree of breakdown. Since small reduction in yields observed in the Pasco, Wash., seed is normal when some seed treatments are used, the overall concept of shipping precut seed appears sound. When recommended conditions during transit are maintained, seed can be shipped in bulk or in burlap bags with minimal losses.

Pallet Containers of Precut Seed in Trucks

The wooden container was the strongest of the four types of pallet containers used, and it could be reused; it was also the most expensive. It caused the most bruising of potatoes, but with minor modifications it could be very useful in transporting bulk potatoes. This container also had a locking device for stacking, which facilitated transport and resulted in no problems of top containers slipping off the bottom ones and causing loss of potatoes and containers.

The 1,400–pound capacity fiberboard container, the larger of the two rectangular ones used in 1970, was constructed so that the bottom flaps covered the entire wooden base pallet and thereby prevented any bruising by the pallet.

The 1,000–pound capacity fiberboard container used in 1972 could easily be stacked in trucks. Since it had no bottom, the potatoes next to the wooden base pallet were bruised. Also, it had no dumping mechanism, and emptying without destroying the container proved to be difficult if not impossible.

The octagonal fiberboard container with top and bottom was the most satisfactory one tested. The octagonal configuration provided strength for stacking and the top and bottom prevented bruising. The advantage of this container over the others was its built-in dumping mechanism, which allowed dumping while still on a forklift.

FACILITIES FOR PRECUTTING SEED

In storage facilities to be used for precutting seed, an independent storage environment should be maintained. The storage area must be entirely separate, or the area where the precutting is done must be permanently or temporarily separated from the remainder of the storage by an insulated, vapor-sealed partition. Failure to meet this requirement will result in undesirable warming of the stock not to be precut, a possible waste of heat, and slow warming of the stock to be cut. Since the temperature difference within the storage will be considerably less than normal inside-to-outside differences, only a minimum of insulation is

needed, such as 2 to 3½ inches of fiberglass. Air circulation systems must also be separate and independent to avoid mixing of atmospheres. If stock is to be put into pallet boxes, the cool area of the storage facility might be used for subsequent cooling once the healing process has been completed.

Design of New Facilities for Handling Precut Seed

If a facility is to be constructed as a multipurpose storage but with the capability of being readily adapted for precutting operations, it should be compartmentalized with a multiatmosphere capacity. The compartments and bins should be sized according to the scale of operation anticipated. Normally the cutting operation should fill at least one bin to the desired depth in 1 day to facilitate management of the curing operation. Each compartment might consist of one to three bins adjacent either laterally or longitudinally (fig. 1).

Each compartment should have a separate fan and control system for air circulation. Humidification equipment should be installed in an enlarged section of the main supply duct. This section usually should be at least 6 feet square by 10 feet long to permit space for the water mist from the humidifier to be evaporated into the airstream. Sometimes smaller equipment will operate in slightly smaller space, but its capacity is very limited.

Humidification can be accomplished by using centrifugal humidifiers, pneumatic nozzles, or steam. Centrifugal humidifiers are fairly expensive in the smaller units but are relatively economical to operate. Pneumatic nozzles require installation of an air compressor. This compressor unit may be slightly less expensive for small capacity installations of up to 3 gallons per hour than centrifugal humidifiers; however, operation of the air compressor is slightly more expensive in power consumption as the size of the unit increases.

Steam is adaptable only to heating operations because of the excess heat present in the steam. For cooling, if humidification is needed, centrifugal or pneumatic-type humidification equipment is required. The humidification system should have a reliable, accurate control unit. The transistorized electronic control units with remote sensing are generally preferred for this purpose.

Heating equipment of standard design should be capable of providing sufficient heat to maintain the compartment temperature and also to raise the temperature of the stock by 1°–1.5° F per day. This means an additional heating capacity of about 6,000 Btu per hour per 1,000 hundredweight of stock being heated.

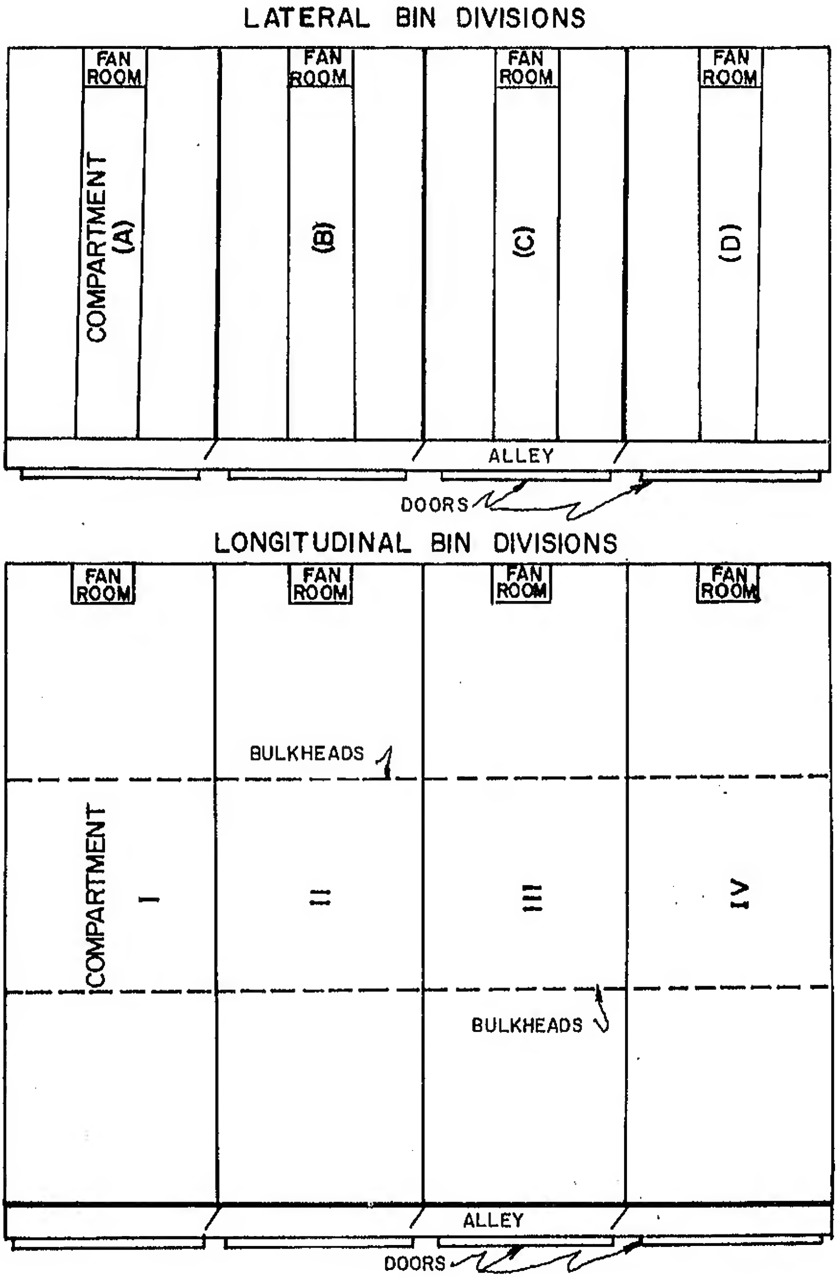

FIGURE 1.—Schema for multiatmosphere storage of seed potatoes.

For this purpose, the heat is best added in the main supply duct upstream of the humidification apparatus.

Fans should be capable of supplying air at the rate of 1 cubic foot per minute per hundredweight at 0.5 inch of mercury static pressure. Normally this should be no problem if the fans are adequate for full bins of whole stock, since cut seed normally should be piled only to about half the bin depth.

Palletized handling and storage in a precutting operation would appear feasible and desirable from the operational standpoint. The stock could be easily moved from its permanent storage location to a special preheating compartment. After cutting, it could be cured in another room designed for this purpose. After curing, it could then be returned to its original storage area for cooling and storage. To attempt to force air through stock stored in pallet boxes is not feasible. Providing an acceptable ambient atmosphere surrounding the pallet boxes is generally sufficient. Local conduction and air movement will normally equilibrate temperature and gas concentrations within a period of hours.

Use of Existing Storage Facilities

Storage facilities presently in use may be adapted for precutting seed. Unless a storage area is designed with a multiatmosphere capability, such adaptation requires remodeling to provide the necessary compartments. If the storage's permanent ventilation-circulation system can be readily adapted for the precutting operation, it should be used. Otherwise some of the ventilating ducts with an auxiliary fan system might be used. Such a system could be portable and integrated with attached heat and humidification equipment (fig. 2).

ECONOMIC EVALUATION OF PRECUTTING SEED POTATOES

Method of Analysis

A partial-budgeting analysis was made to compare the cost of precutting seed potatoes, as well as machine cutting at planting time, with the handling of whole seed potatoes. The analysis reflects only those costs that are in addition to those of handling whole seed. The procedures that are the same for precutting or cutting as for handling whole seed and not included in this analysis are (1) supplying the line with field-run potatoes from storage, (2) removing undersize, (3) grading, and (4) handling oversize. The cost of returning the cut seed to storage is peculiar

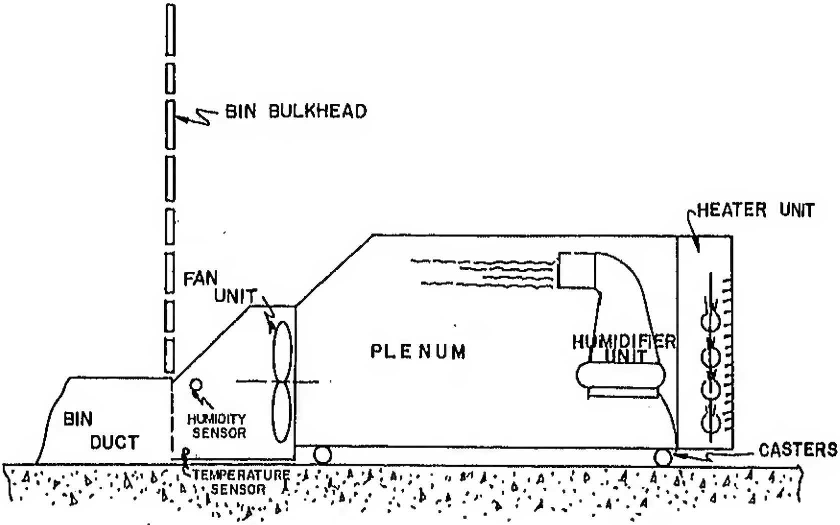

FIGURE 2.—Schema for portable environmental control unit for precutting seed potatoes.

to precutting, but it is assumed here to be the same as the cost of loading whole seed in bulk in transporting carriers.

The sequence in the production of precut seed potatoes is as follows: Beginning with certified field-run potatoes in storage, the lot to be cut is warmed to provide near optimum temperatures for suberization of cut surfaces. The potatoes are removed from storage, sized, graded, cut with a mechanical seed cutter, and treated with a fungicide. The cut pieces are then replaced in a storage area. For 6 to 10 days sufficient heat and moisture are added to the storage area to maintain suberization conditions. The lot is then cooled to restrict sprouting. Once cooled, the precut seed is maintained as for whole seed potatoes until removal for shipment. For this analysis, removal was assumed to occur at 60 days from the cutting date. The quantity considered is meant to reflect the amount used by a commercial seed grower who precuts potatoes for a large volume of sale, as well as that used by a grower who precuts only those for his own use.

The additional costs incurred in producing precut seed are for (1) ownership and operation of cutting and dusting equipment, (2) additional labor to assist the seed cutter, (3) suberizing the seed pieces, (4) adding seed treatment dust, and (5) labor and operation of removing the cut seed from storage and loading for shipment. Ownership costs of equipment used in loading for

shipment, for heating, and humidification were assumed to be borne by other operations rather than proportioned separately.

Several costs held constant in the analysis rather than scaled to reflect reductions from volume consumption were electricity at 3.5 cents per kilowatt-hour with 1 horsepower equal to 1 kilowatt, liquefied petroleum gas at 35 cents per gallon, and seed treatment dust at $15.40 per hundredweight, with dust added to cut potatoes at 1 pound per hundredweight. Other constant costs were interest at 8 percent, taxes at 3.2 percent, and insurance at 1.75 percent—all at the average value of the equipment—and labor at $1.80 per hour plus 8.74 percent for payroll taxes with no overtime. Repair and maintenance of equipment were assumed to be 2 percent of the new cost plus 0.006 percent of the new cost per hour of operation. These costs reflect 1972 price levels.

The useful life of the seed cutter was assumed to be 8 years with a 10-percent salvage value. A power requirement was established of 1.5 horsepower to operate the equipment. In assessing the costs of providing the atmosphere for the proper curing and subsequent storing of the cut seed, the heat requirement was based on 0.95 Btu raising the temperature of 1 pound of potatoes 1° F, with the input volume raised 10° in the operation. Requirements for water in humidification were based on rates of 0.5 cubic foot per minute of airflow. Forced circulation was assumed to be continuous for the first 24 hours of cut-seed storage and at intervals comprising 15 percent of the time, such as 9 minutes each hour, for the remaining days of storage.

Factors that varied for the analysis were (1) volume, (2) new cost of equipment, (3) rate of cutting, (4) number of laborers assisting the cutter, and (5) number of laborers loading for shipment.

Since seed potatoes are sold on a weight basis, a comparison was made of precut seed potatoes with whole potatoes to account for differences in weight loss between the two. The greater loss from the precut potatoes would be considered as an additional cost of the operation. Table 11 itemizes the losses for Kennebec and Russet Burbank varieties when handled as whole and precut seed, based on data given previously in this report.

Results and Discussion

The additional cost of selling precut seed potatoes as compared with whole potatoes is affected by the variety handled. As shown by two varieties, the differences are primarily due to weight loss

TABLE 11.—*Storage and handling weight losses for Kennebec and Russet Burbank potatoes when processed as whole seed and as precut seed during comparable 60-day storage period*

Item	Kennebec	Russet Burbank
Whole seed	*Pounds*	*Pounds*
Weight—		
At beginning of storage	100.00	100.00
Loss during storage (Kennebec 1.08 and Russet Burbank 0.75 percent)	1.08	.75
When removed from storage	98.92	99.25
Loss in sizing and grading (30 percent)	29.68	29.78
When for sale	69.24	69.47
Precut seed		
Weight—		
At beginning of storage	100.00	100.00
Loss in sizing and grading (30 percent)	30.00	30.00
When proceeding through mechanical cutter	70.00	70.00
Loss in cutting (Kennebec 0.5 and Russet Burbank 4.5 percent)	.35	3.15
When proceeding through duster	69.65	66.85
Of added dust (1 lb/100 cwt)	.70	.67
When placed in storage	70.35	67.52
Loss during storage (Kennebec 4.5 and Russet Burbank 4.83 percent)	3.20	3.26
When removed from storage for sale	67.15	64.26
Decrease (percent) from whole seed	3.02	7.50

during storage and to cutting losses, since long varieties tend to produce greater waste than round varieties.

The additional cost of producing precut Kennebec potatoes ranged from 12¼ cents to $1.30 per hundredweight available for sale, depending on the cost of the seed-cutting equipment and the volume of potatoes handled. For precut Russet Burbank potatoes, the cost was from 2 to 4 percent higher (table 12). The volume handled greatly affects the unit cost of precut seed. The additional cost per unit decreases rapidly with increased volume after a beginning total input with field-run potatoes of 1,000 hundredweight annually. The cost then levels out and decreases little beyond inputs of 40,000 hundredweight (fig. 3).

The additional cost of precut seed, given in table 12, was determined with the following variables held constant: Portion of field-run potatoes entering the seed cutter, 70 percent; rate of

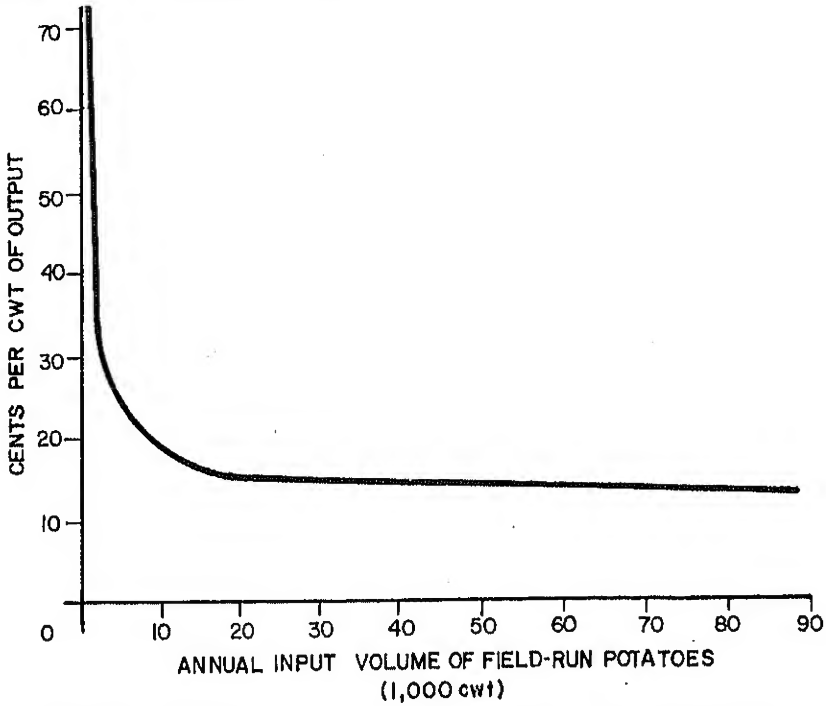

FIGURE 3.—Additional cost of precutting Kennebec seed potatoes over machine cutting at planting time.

cutting, 90 hundredweight per hour or 150 pounds per minute; loss in cutting, 0.5 percent for Kennebec and 4.5 percent for Russet Burbank; extra labor to assist cutter and duster, one man; weight loss during storage, 4.6 percent for Kennebec and 4.8 percent for Russet Burbank; labor used to load seed for shipment, four men; and loading rate, 1,000 hundredweight per day.

With these variables held constant, a $1,000 change of investment in equipment results in a constant change in unit cost at each given volume of input. For example, when input volume of Kennebec potatoes was held at 2,500 hundredweight, increasing the investment in equipment from $2,000 to $3,000 increased the cost per hundredweight of output about 12 cents, from 35.47 to 47.29 cents (table 12). Increasing investment from $3,000 to $4,000 also increased the cost per hundredweight about 12 cents, from 47.29 to 59.11 cents. With Russet Burbank the unit cost increases about 12.4 cents per $1,000 of increased investment. As the input volume level is increased, the increase in unit cost per $1,000 of increased equipment cost is less; e.g., with the Kennebec variety, the increase was 5.9 cents per hundredweight at

TABLE 12.—*Cost of producing precut Kennebec and Russet Burbank seed potatoes in excess of cost of producing them as whole potatoes at 4 investment levels in cutting and dusting equipment for various input volumes* [1]

Annual input volume (cwt)	Volume available for sale	New cost per cwt of cutter and duster at indicated investment			
		$1,000	$2,000	$3,000	$4,000
	Cwt	*Cents*	*Cents*	*Cents*	*Cents*
		KENNEBEC			
1,000	671	41.27	70.72	100.17	129.61
2,500	1,679	23.65	35.47	47.29	59.11
5,000	3,357	17.77	23.72	29.66	35.61
7,500	5,036	15.82	19.80	23.79	27.77
10,000	6,715	14.84	17.84	20.85	23.86
22,500	15,108	13.20	14.58	15.95	17.33
35,000	23,501	12.74	13.65	14.56	15.46
50,000	33,573	12.48	13.14	13.80	14.46
90,000	60,431	12.22	12.62	13.02	13.41
		RUSSET BURBANK			
1,000	643	42.80	73.56	104.34	135.10
2,500	1,060	24.38	36.73	49.08	61.43
5,000	3,213	18.24	24.45	30.66	36.87
7,500	4,819	16.19	20.36	24.52	28.69
10,000	6,426	15.17	18.31	21.45	24.60
22,500	14,458	13.46	14.90	16.34	17.77
35,000	22,490	12.98	13.93	14.88	15.82
50,000	32,129	12.71	13.40	14.09	14.77
90,000	57,832	12.44	12.85	13.27	13.68

[1] For variables held constant, see text. Costs are representative of 1972 price levels as given by dealers for cutters and dusters. Quoted capacity for all equipment was approximately 100–200 cwt/h.

5,000 input volume, 3.0 cents at 10,000 hundredweight, and 0.9 cent at 35,000 hundredweight.

A change in the rate of cutting also has a constant effect on unit cost at all volumes and becomes lower as the rate of cutting is increased. With the Kennebec variety, a cutting rate of 90 hundredweight per hour produces a cost of 1.22 cents per hundredweight lower than would 60 hundredweight per hour. An increase in cutting rate from 90 to 150 hundredweight per hour would lower the unit cost by 0.98 cent, whereas an increase in cutting rate to 210 hundredweight per hour would lower the unit cost another 0.42 cent.

The effect of labor input is also constant at all levels of volume, provided the handling rates are not altered. A one-man change

in the number used with the cutter and duster changes the additional cost per hundredweight for Kennebec by 2.25 cents, whereas a one-man change in the number used to load the cut seed changes the cost by 1.75 cents per hundredweight of cut seed removed from storage.

For a comparison of a grower who machine cuts at planting time rather than one who precuts seed for his own use, the analysis was made deleting the costs of curing the precut seed and loading for shipment. The starting point for comparison was assumed to be 2 months prior to planting, with the weight loss of the whole seed during this period accounted for in the analysis. The lower weight-loss rate for whole seed during this period results in a greater weight of fresh-cut seed being produced than that obtained were the lot handled as precut. For example, 1,000 hundredweight of Kennebec potatoes would yield 671 hundredweight of seed for sale or planting if handled as precut (table 12) as compared with 696 hundredweight if handled as fresh-cut seed (table 13). Table 13 gives the additional costs of machine cutting at planting time in relation to grading and sizing only. These costs are lower than the precutting costs primarily because of the rehandling required in precutting.

A comparison of the unit costs in these two processes indicates that, with the $2,000 investment in cutting and dusting equipment, fresh-cut seed costs 10.2 cents less per hundredweight at the input volume of 1,000 hundredweight, 8.3 cents less at 10,000, and 8.1 cents less at 90,000. The change in costs follows the same pattern as in figure 3.

A grower precutting seed potatoes for his own use may find his cost 8 to 10 cents per hundredweight more than if he machine cuts directly for planting, assuming he pays his labor at the same rate in both methods. An advantage might be gained in precutting, however, by utilizing lower cost labor during relatively slack periods of his planting season. A grower precutting for commercial sales may find that an additional charge of 25 cents per hundredweight or less will cover the additional costs he incurs over that of shipping whole seed. However, there is little incentive to perform the service if additional returns fail to exceed the additional costs. A fee for the service is expected. The risk or uncertainty the producer faces of loss in his seed potatoes should be considered.

Since properly healed precut seed offers growers the advantage of small whole seed potatoes, referred to here as size B, the price differential between size B and regular seed might indicate

TABLE 13.—*Cost of machine cutting Kennebec and Russet Burbank seed potatoes at planting time in excess of cost of grading and sizing at 4 investment levels in cutting and dusting equipment for various input volumes* [1]

Annual input volume (cwt)	Volume produced	New cost per cwt of cutter and duster at indicated investment $1,000	$2,000	$3,000	$4,000
	Cwt	*Cents*	*Cents*	*Cents*	*Cents*
		KENNEBEC			
1,000	696	32.14	60.55	88.96	117.38
2,500	1,740	15.13	26.54	37.54	49.35
5,000	3,579	9.46	15.20	20.93	26.67
7,500	5,219	7.57	11.42	15.26	19.11
10,000	6,959	6.63	9.53	12.43	15.33
22,500	15,657	5.05	6.38	7.70	9.03
35,000	24,355	4.60	5.48	6.36	7.23
50,000	34,793	4.36	4.99	5.63	6.26
90,000	62,628	4.11	4.49	4.87	5.25
		RUSSET BURBANK			
1,000	670	33.32	62.83	92.83	121.84
2,500	1,675	15.66	27.50	39.35	51.19
5,000	3,351	9.78	15.73	21.69	27.64
7,500	5,026	7.81	11.81	15.80	19.79
10,000	6,701	6.83	9.84	12.86	15.87
22,500	15,078	5.20	6.57	7.95	9.33
35,000	23,454	4.73	5.64	6.55	77.46
50,000	33,506	4.48	5.31	5.79	6.45
90,000	60,311	4.22	4.61	5.01	5.40

[1]Annual input volume is assumed as amount on day precutting would have started in order to make 2 methods of handling comparable. For variables held constant, see text.

a maximum difference between the prices of regular and precut seed of comparable quality. The premium for Maine-grown size B Katahdin seed potatoes for 1965 through 1968 averaged $1.25 to $1.60 per hundredweight (table 14). For the 1969 crop, however, the premium averaged only $0.31, possibly because of the ample supply of seed size tubers in the crop of that year and the trend toward increased use of mechanical seed cutters and decreased use of the Katahdin variety since 1968. Premiums received for potatoes 1.875—2.50 inches in diameter might be considered as the premiums expected for precut seed. They ranged from $0.40 to $0.75 per hundredweight in 1965–68, were only $0.06 in 1969, and attained $0.29 in 1970 and $0.39 in 1971.

TABLE 14.—*Average prices and premiums for Maine-grown Katahdin certified seed potatoes, 1965–71* [1]

Crop year	Price of regular seed	Price of—		Premium over price of regular seed of—	
		1.875–2.50 inch seed	Size B seed	1.875–2.50 inch seed	Size B seed
1965	$2.94	$3.42	$4.22	$0.48	$1.28
1966	2.25	3.00	3.85	.75	1.60
1967	1.54	1.94	2.79	.40	1.25
1968	2.25	2.78	3.52	.53	1.27
1969	2.97	3.03	3.28	.06	.31
1970	2.32	2.61	3.02	.29	.70
1971	2.24	2.63	3.03	.39	.79

[1]Determined from Federal-State Market News Service quotations for prices f.o.b. shipping point, delivered, Presque Isle rate of freight, less all transportation charges, tagged, and loaded, including average brokerage fee.

RECOMMENDED PROCEDURES FOR HANDLING PRECUT SEED POTATOES

(1) Select disease- and bruise-free certified seed potatoes for cutting.

(2) Precutting should not be part of a salvage operation.

(3) Warm seed potatoes to 50° F before moving from storage.

(4) Clean and disinfect all equipment to be used in precutting.

(5) Size tubers prior to or during cutting.

(6) Cut tubers into blocky 1.5– to 2–ounce seed pieces with at least one eye each.

(7) Keep cutter knives sharp to prevent ripping cut surface, which provides an entry for decay organisms.

(8) Remove off-size pieces of potato.

(9) Treat acceptable seed pieces with a chemical.

(10) Place precut seed in storage.

(11) Cure 6 to 10 days with a good air supply at 50°–60° F and 95 percent or higher relative humidity.

(12) Cool to 40° F and maintain relative humidity at 95 percent for remaining storage period.

(13) Warm to 50° F before removal from storage.

(14) Transport.

(15) Plant.

SUMMARY

Certified seed potatoes were cut from 60 to 150 days before planting, treated with chemicals, and stored in bulk bins or pallet boxes until planted. The resulting stands and yields were equal to or greater than those obtained with fresh-cut seed. Mertect and Benlate provided the highest control of seed piece decay.

Bulk hopper railcars, pallets, and conventional 100-pound burlap bags were satisfactory for precut seed shipment.

Descriptions of equipment, procedures, and structure plans are included as well as recommendations for precutting seed.

An economic analysis showed that the cost of precutting seed ranged from about $0.12 to $1.30 per hundredweight.

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APPENDIX

The following fungicides were used in these studies:

	Company, common, and chemical names and formulation
Benlate	E. I. duPont de Nemours & Co., Inc. Benomyl (methyl 1-(butylcarbamoyl)-2-benzimidazolecarbamate); 50-percent wettable powder and 10-percent dust formulated with Attaclay X 250 as diluent.
Bravo	Diamond Shamrock Chemical Co. Chlorothalonil (tetrachloroisophthalonitrile); 75-percent wettable powder.
Captan	Chevron Chemical Co. Captan (*N*-[(trichloromethyl) thio]-4-cyclohexene-1,2-dicarboximide); 7.5-percent dust.
Dithane M-45	Rohm and Haas Co. Coordination product of zinc ion and manganous ethylenebis [dithiocarbamate]; 80-percent wettable powder and 8-percent dust.
Dustret	Agsco Chemicals, Inc. Mixture of zinc ethylenebisdithiocarbamate and streptomycin sulfate.
Dustret-A	Agsco Chemicals, Inc. Mixture of manganous ethylenebis [dithiocarbamate] and streptomycin sulfate.
Mertect	Merck and Co., Inc. Thiabendazole (2-(4-thiazolyl)-benzimidazole); 60-percent wettable powder.
Polyram	FMC Corp. Mixture of 5.2 parts by weight of ammoniates of [ethylenebis (dithiocarbamate)] zinc and 1 part by weight of ethylenebis[dithiocarbamic acid], bimolecular and trimolecular cyclic anhydrosulfides and disulfides; 80-percent wettable powder and 8-percent dust.
Semesan Bel	E. I. duPont de Nemours & Co., Inc. Mixture of 2-chloro-4-(hydroxymercuri)phenol and 2-chloro-4-(hydroxymercuri)nitrophenol (mercury equivalent 9.5 percent); 16.8-percent wettable powder.

The following equipment and specifications are required to precut seed potatoes:

(1) Bulk scoop or other method of supplying seed cutter with whole potatoes to be cut.

(2) Seed cutter.
(3) Mechanical seed treater.
(4) Chemical seed treater.
(5) Conveyor, bin piler, or pallet-box filler.
(6) Palletized containers or bins for curing and storage.
(7) Equipment for maintaining proper environmental conditions during curing and storing:
- (a) Fan: Capacity 1 cubic foot per minute per hundredweight at one-half inch mercury static pressure.
- (b) Fan controls: Interval timer, magnetic motor control.
- (c) Humidification equipment: Capacity of approximately 2 gallons per hour per 1,000 hundredweight of stock. Pneumatic nozzles supply approximately 0.6 gallon per hour each. Output of centrifugal humidifiers is specified by manufacturer.
- (d) Humidification controls: Range 70–100 percent, accuracy ± 2 percent.
- (e) Auxiliary heating equipment: Capacity 6,000 Btu per hour per 1,000 hundredweight. Type: Gas, oil, electricity, or steam with warm-air output.
- (f) Heating controls: Thermostatic 30°–70° F range, accuracy ± 2.
- (g) Cooling capacity: One-half ton per 1,000 hundredweight or air at 35°–40° F.

(8) Bin-emptying equipment—bin unloader, pallet-box dumper, or bulk scoop.
(9) Truck and railcar loading equipment.
(10) Means of transport.

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